



PCT/GB 2003 / 0 0 3 7 0 6
Rec'd PCT/PTO 14 MAR 2005
INVESTOR IN PEOPLE

PRIORITY DOCUMENT

SUBMITTED OR TRANSMITTED IN
COMPLIANCE WITH RULE 17.1(a) OR
(b)

The Patent Office

Concept House

Cardiff Road

Newport REC'D 25 SEP 2003

South Wales

NP10 800 WIPO

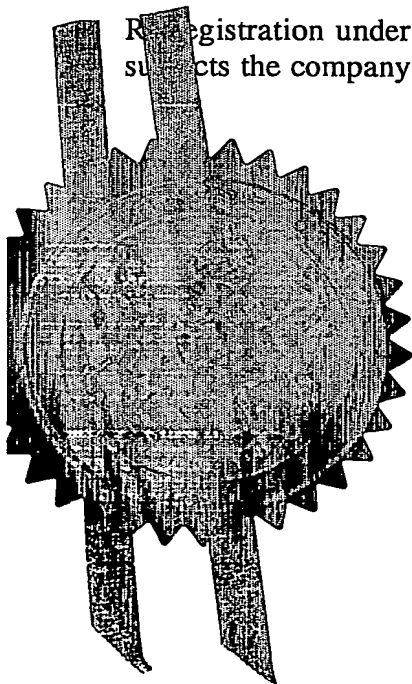
PCT

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.



Signed

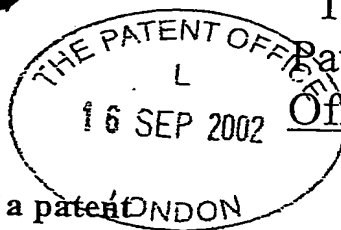
W. Evans

Dated

15 September 2003

BEST AVAILABLE COPY

1/77



Request for grant of a patent LONDON

The Patent Office
Cardiff Road
Newport
Gwent NP9 1RH

1.	Your reference	8841 GB/JEB/GW
----	----------------	----------------

2. Patent application number
(The Patent Office will fill in this part)

3..	Full name, address and postcode of the or of each applicant (<i>underline all surnames</i>)	D W Spinks (Embossing) Limited Unit 3, Hale Wharf Berry Lane
-----	--	--

08465593001

Patents ADP number (if you know it)

If the applicant is a corporate body,
give the country/state of its
incorporation

Ferry Lane
Tottenham 116 500 000 0221449.2
London
N17 9NF

United Kingdom

4.	Title of the invention	Rainbow fibres
----	------------------------	----------------

5. Name of your agent (if you have one) Abel & Imray

"Address for service" in the United Kingdom to which all correspondence should be sent (*including the postcode*)

20 Red Lion Street
London
WC1R 4PO

Patents ADP number (if you know it) 174001

6.	If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and <i>(if you know it)</i> the or each application number	Country	Priority application number <i>(if you know it)</i>	Date of filing <i>(day/month/year)</i>
----	--	---------	--	---

7.	If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application	Number of earlier application	Date of filing (day/month/year)
----	--	-------------------------------	------------------------------------

8.	Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if: a) any applicant named in part 3 is not an inventor, or b) there is an inventor who is not named as an applicant, or c) any named applicant is a corporate body. See note (d))	Yes
----	--	-----

9. Enter the number of sheets for any of the following items you are filing with this form.
Do not count copies of the same documents.

Continuation sheets of this form

Description 13

Claim(s) 4 *DM*

Abstract 0

Drawing(s) 1+1

10. If you are also filing any of the following, state how many against each item.

Priority documents

Translations of priority documents

Statement of inventorship and right to grant of a patent (*Patents Form 7/77*)

Request for preliminary examination and search (*Patents Form 9/77*)

Request for substantive examination (*Patents Form 10/77*)

Any other documents
(*please specify*)

11. I/We request the grant of a patent on the basis of this application.

Signature

Date

Abel & Imray
Abel & Imray

16 September 2002

12. Name and daytime telephone number of person to contact in the United Kingdom Gary Whiting 020 7405 0203

Rainbow Fibres

The present invention relates to fibres having a number of coloured fluorescent stripes or regions that are visible only under ultra-violet light. The present invention also relates to paper products incorporating such fibres.

It is known to provide a number of paper products, such as bank notes, cheques, passports, identity papers and fiduciary papers, with some form of counterfeit protection. A number of counterfeit protection measures are known in the art. They include watermarks, holograms, the provision of metallic strips through the paper, the use of fluorescent particles and the use of optically variable inks and coatings.

Problems with known counterfeit protection measures include the expense of some options and the ease with which some options can be overcome, for example by utilizing methods including digital or laser printing, scanning, photography and xerography. Another problem is the difficulty in raising public awareness of some of the measures, especially in relation to counterfeit protection for bank notes.

It is an object of the present invention to provide an alternative means of providing counterfeit protection that addresses at least some of the above-mentioned problems.

The present invention provides a fibre having a front side and a rear side and having a plurality of striped regions printed on said front and rear sides, wherein said striped regions are coloured and are visible only under ultra-violet light, said stripes including stripes having three or more colours. The stripes may include stripes having at least

four colours. Those colours may include at least red, yellow, blue and green.

The stripes are preferably printed on the front and rear
5 sides of the fibre such that stripes on the front and rear
sides are in register with one another and have the same
colour. This ensures that, if the fibres are incorporated
into a paper product, the printed stripes will be visible,
given the appropriate light conditions, regardless of the
10 orientation of the fibre in the paper product.

In one preferred embodiment, the stripes abut one another
with no overlap of colour at the boundaries of the stripes.
The pigments used for generating the printed stripes do not
15 generally combine well, hence the desire to prevent the
printed stripes from overlapping. Further, if the fibres are
incorporated into a paper product, the provision of
fluorescent printed stripes that abut against one another
exactly results in a pattern that is difficult to replicate,
20 thereby offering good counterfeit protection.

The stripes may be placed at about 1mm gradations. The width
of the stripes can be more or less than 1mm, but it has been
found that 1mm results in a particularly effective optical
25 effect when the fibres are incorporated into a paper product.
Hence, a width of the order of 1mm (0.5 to 1.5 mm) may
advantageously be chosen since it offers good counterfeit
protection.

30 The dimensions of the fibres themselves can be varied.
Typical lengths that have been used are 3mm, 4mm, 5mm, 6mm,
7mm, 8mm, 9mm and 10mm. Typical widths that have been used
are 0.125mm, 0.15mm, 0.2mm, 0.25mm, 0.3mm, 0.35mm, 0.4mm,
0.45mm and 0.5mm.

The fibre may be tissue paper or an alternative thin paper. The paper may be provided without optical brighteners.

- 5 The present invention also provides a fibre having a front side and a rear side and having a plurality of regions printed on said front and rear sides, wherein said regions are coloured and are visible only under ultra-violet light.
- 10 The regions may include regions having at least three colours. In one preferred embodiment, the regions include regions having at least four colours, which may include red, yellow, blue and green.
- 15 The regions are preferably printed on the front and rear sides of the fibre such that regions on the front and rear sides are in register with one another and have the same colour. This ensures that, if the fibres are incorporated into a paper product, the printed regions will be visible,
20 given the appropriate light conditions, regardless of the orientation of the fibre in the paper product.

- The regions may abut one another with no overlap of colour at the boundaries of the regions. As noted above, the pigments
25 used for generating the printed regions do not generally combine well, hence the desire to prevent the printed regions from overlapping. Further, if the fibres are incorporated into a paper product, the provision of fluorescent printed regions that abut against one another exactly results in a
30 pattern that is difficult to replicate, thereby offering good counterfeit protection.

The printed regions are preferably arranged in a pseudo-random pattern, which may be computer generated. This

increases the counterfeit protection of a paper product incorporating such a fibre.

The fibre may be tissue paper or an alternative thin paper.

5 The paper may be provided without optical brighteners.

The printed stripes or regions may appear in a repeating pattern, for example by providing stripes that appear in the same order. The fibre may be cut from a larger fibre. For
10 example, a long fibre having a repeating pattern of printing stripes may be cut into a number of smaller fibres. These smaller fibres may be cut in a random or pseudo-random fashion so that the pattern of printed stripes in each fibre starts and finishes in a different place. The effect of
15 cutting the fibres in this manner is to provide a number of different fibres that can be used to create an unpredictable pattern when incorporated into a paper product. The provision of a plurality of fibres in a paper product, each fibre having a series of stripes or regions starting in a
20 different position can result in an overall pattern that is unpredictable and difficult to replicate, yet relatively straightforward to describe.

A fibre in accordance with the present invention may have a
25 layer of varnish applied to the outer surface of the fibre. The provision of a layer of varnish may be applied to protect the printed stripes or regions against abrasion and/or to improves the affinity of the fibres with a paper product into which the fibre is incorporated.

30

The present invention also provides a method of manufacturing a fibre, the method comprising the steps of printing a plurality of striped regions on front and rear sides of the fibre, wherein said striped regions are coloured and are

visible only under ultra-violet light, said stripes including stripes having three or more colours. The stripes may include stripes having at least four colours. Those colours may include at least red, yellow, blue and/or green.

5

The step of printing said plurality of striped regions preferably includes the step of printing on the front and rear sides of the fibre such that stripes on the front and rear sides are in register with one another and have the same
10 colour. This ensures that, if the fibres are incorporated into a paper product, the printed regions will be visible, given the appropriate light conditions, regardless of the orientation of the fibre in the paper product.

15 The stripes may abut one another with no overlap of colour at the boundaries of the stripes. As noted above, the pigments used for generating the printed stripes do not generally combine well, hence the desire to prevent the printed stripes from overlapping. Further, if the fibres are incorporated
20 into a paper product, the provision of fluorescent printed stripes that abut against one another exactly results in a pattern that is difficult to replicate, thereby offering good counterfeit protection.

25 The stripes may be placed at about 1mm gradations. The width of the stripes can be more or less than 1mm, but it has been found that 1mm results in a particularly effective optical effect when the fibres are incorporated into a paper product. Hence, a width of the order of 1mm (0.5 to 1.5 mm) may
30 advantageously be chosen since it offers good counterfeit protection.

The dimensions of the fibres themselves can be varied. Typical lengths that have been used are 3mm, 4mm, 5mm, 6mm,

7mm, 8mm, 9mm and 10mm. Typical widths that have been used are 0.125mm, 0.15mm, 0.2mm, 0.25mm, 0.3mm, 0.35mm, 0.4mm, 0.45mm and 0.5mm.

- 5 The fibre may be tissue paper or an alternative thin paper.
The paper may be provided without optical brighteners.

The present invention further provides a method of manufacturing a fibre, the method comprising the steps of
10 printing a plurality of regions on front and rear sides of said fibre, wherein said regions are coloured and are visible only under ultra-violet light.

The regions may include regions having at least three
15 colours. In one preferred embodiment, the regions include regions having at least four colours, which may include red, yellow, blue and green.

The regions are preferably printed on the front and rear
20 sides of the fibre such that regions on the front and rear sides are in register with one another and have the same colour. This ensures that, if the fibres are incorporated into a paper product, the printed regions will be visible, given the appropriate light conditions, regardless of the
25 orientation of the fibre in the paper product.

The regions may abut one another with no overlap of colour at the boundaries of the regions. As noted above, the pigments used for generating the printed regions do not generally
30 combine well, hence the desire to prevent the printed regions from overlapping. Further, if the fibres are incorporated into a paper product, the provision of fluorescent printed regions that abut against one another exactly results in a

pattern that is difficult to replicate, thereby offering good counterfeit protection.

5 The printed regions are preferably arranged in a pseudo-random pattern which may be computer generated. This increases the counterfeit protection of a paper product incorporating such a fibre.

10 The fibre may be tissue paper or an alternative thin paper. The paper may be provided without optical brighteners.

15 The printed stripes or regions may appear in a repeating pattern, for example by providing stripes that appear in the same order. The fibre may be cut from a larger fibre. For example, a long fibre having a repeating pattern of printing stripes may be cut into a number of smaller fibres. These smaller fibres may be cut in a random fashion so that the pattern of printed stripes in each fibre starts and finishes in a different place. The effect of cutting the fibres in
20 this manner is to provide a number of different fibres that can be used to create an unpredictable pattern when incorporated into a paper product. The provision of a plurality of fibres in a paper product, each fibre having a series of stripes or regions starting in a different position
25 can result in an overall pattern that is unpredictable and difficult to replicate, yet relatively straightforward to describe.

30 The method of manufacturing a fibre may include the step of applying a layer of varnish to the outer surface of the fibre. The application of a layer of varnish protects the printed stripes or regions against abrasion and may be used to improves the affinity of the fibres with a paper product into which the fibre is incorporated.

The present invention also provides a method of manufacturing a paper product, the method comprising the steps of mixing any of fibres described above with slurry paper pulp such
5 that the fibres form a hydrogen bond with the cellulose fibre
in the paper pulp and forming the paper pulp and fibre mix into a continuous web of paper.

The present invention further provides a paper product
10 containing a plurality of the fibres described above.

By way of example only, embodiments of the present invention will now be described with reference to the accompanying drawings, of which:

15

Figure 1 shows a fibre in accordance with a first embodiment of the invention;

Figure 2 shows a fibre in accordance with a second embodiment of the present invention.

20

Figure 1 shows a fibre, indicated generally by the reference numeral 2, in accordance with a first embodiment of the present invention. The fibre 2 includes stripes 4, 6, 8, 10 and 12 each extending across the width of the fibre; the
25 stripes are each 1mm long and the series of stripes extends across the length of the fibre.

The fibre shown in Figure 1 is 5mm long and 0.2 mm wide but other dimensions are possible.

30

Each stripe has a fluorescent colouring that is only visible under ultra-violet light. Each fibre includes stripes having at least three different colours, such as red, yellow, blue and green. In one embodiment, the colours are visible when

ultraviolet light having a wavelength between 245nm and 365nm is shone at the fibre. In any particular embodiment, and for any particular colour, the wavelengths at which the colours are visible are dependent on the pigments used to generate
5 the prints.

The coloured stripes are printed on both sides of the fibre and are exactly in register such that each colour appears exactly over the corresponding colour on the other side of
10 the fibre. Further, the coloured stripes abut one another such that there is no overlap of colours at the boundary of the stripes.

The fibres are produced so that the coloured stripes appear
15 in the same order in a repeating pattern. However, the array of stripes start and finish in a random or pseudo-random fashion so that the fibres differ from one another. In the manufacturing process, the fibres are cut to the same length (e.g. 3mm, 5mm or 6mm depending on the length chosen) but the
20 fibres are presented to the cutting equipment such that the cut appears at different positions relative to the repeated printing pattern, thereby producing a random or pseudo-random cut.

25 Figure 2 shows a fibre, indicated generally by the reference numeral 14, in accordance with a second embodiment of the present invention. The fibre 2 includes regions 16, 18, 20, 22 and 24 arranged in a pseudo-random fashion on the fibre. The pattern of the regions is generated by a computer program
30 such that each pattern is different.

As with the stripes of the first embodiment, each region has a fluorescent colouring that is only visible under ultra-violet light. Each fibre includes regions having different

colours, such as red, yellow, blue and green. As before, the colours may be visible when ultraviolet light having a wavelength between 245nm and 365nm is shone at the fibre.

5 As in the first embodiment, the coloured regions are printed
on both sides of the fibre and are exactly in register such
that each colour appears exactly over the corresponding
colour on the other side of the fibre. Further, the coloured
stripes abut one another such that there is no overlap of
10 colours at the boundary of the regions.

In addition to the pseudo-random nature of the printed
patterns, the fibres are cut in a random or pseudo-random
fashion in a similar manner to the fibres of the first
15 embodiment.

The fibres of both the first and second embodiments of the
invention are manufactured from tissue or thin paper without
optical brighteners. The optimum paper is a high porosity,
20 high wet strength tissue paper with a nominal basis weight of
25 grams per square metre. The substance of the paper is
significant since the ability to print and cut a thin
material provides a technical barrier to duplicating the
fibres.

25

Fibres in accordance with the present invention have been
manufactured using paper having the properties listed below.
These properties have been developed with the intention of
providing a fibre that works well but are only one example.
30 Other papers could be used.

Properties	Units	Minimum	Maximum	Average
Substance	g/m ²	15	45	24.8
Lemm capillary climb md	mm	16	17	16.6
Wet tensile strength	N/15mm	4.5	5.9	5.14
Bulk	Cm ³ /g	2.4	2.5	2.46
High porosity	1/mn/100cm ²	24	31.2	27.9
Humidity	%	4.9	7.0	4.98
pH of aqueous extract				6.8

In addition, the target Bensten porosity (defined by ISO standard 5636/3) is 1500 ml/mm, the minimum Bensten value is
5 700 ml/mm

In one embodiment of the invention, four different coloured stripes or regions are used, those colours are red, yellow, green and blue. As noted above, the colours are printed onto
10 the fibre. Suitable products for this printing process have been developed from commercially available pigments.

Each of the red, yellow, green and blue prints in the range has a minimum Blue Wool lightfastness of 3, an excitation
15 wavelength in the region of 365nm and good chemical resistance.

As noted above, fibres in accordance with the present invention can be incorporated into a paper product, such as a
20 bank note, as a counterfeit protection device.

Paper products in accordance with the present invention are made by mixing slurry paper pulp with the fibres of the

present invention. The fibres of the present invention form a hydrogen bond with the cellulose fibres in the paper pulp and when the pulp is formed into a continuous web of paper, the fibres in the pulp become an integral part of the web or
5 sheet of paper. The coloured stripes or regions of the
----- fibres can only be seen under ultra-violet light, thereby
providing a security feature that cannot be seen in normal light conditions.

10 The substance of the fibres that are mixed with the slurry paper pulp are important since the use of a thin material improves the affinity of the fibres within the formed web of paper. This affinity can also be assisted by using a material with a high porosity. Furthermore, a material with
15 a high wet tensile strength is an advantage since this will reduce the likelihood of the material disintegrating during the paper production process.

Before the fibres of the present invention are mixed with the
20 paper, the fibres are coated with a varnish. The varnish protects the print against abrasion and also improves the affinity of the fibres in the finished paper. In one embodiment, the varnish used is a 4% solution of Solvitose NX in acrylic water based binder that is applied to both sides
25 of the printed material.

----- In both embodiments of the fibre described above, the print
is applied to both sides of the fibre. This is advantageous since, in this finished paper product, the orientation of
30 each individual fibre is unknown. If both sides of the fibre include the print, this will be visible regardless of which side is facing upwards.

The printed stripes or regions abut one another and do not overlap. Further, the pigments are selected so that there is no migration of colours into one another and no leeching or migration of the pigments into the surrounding paper.

5

The fibres incorporated into paper products are not visible in ordinary light conditions. Thus, the normal appearance of the paper product is not affected by the incorporation of the fibres into the paper.

10

The fibres according to the first embodiment of the invention are cut in different places to provide a range of different fibre and those fibres are incorporated into the paper in a range of different orientations and at different depths in the paper. The resulting pattern, when viewed under appropriate light conditions is very difficult to replicate and hence provides good counterfeit protection.

15

Further, fibres in accordance with the second embodiment of the invention have the added feature of pseudo-random printed patterns on the fibres to add an extra degree of randomness to the optical effect on the user. This extra complexity makes it even more difficult to replicate the optical effect.

20

25 In addition to being difficult to replicate, the optical effect is striking and relatively easy to describe to the general public.

Claims

1. A fibre having a plurality of striped regions printed on front and rear sides of said fibre, wherein:
5 said striped regions are coloured and are visible only
----- under ultra-violet light, said stripes including stripes -----
having three or more colours.
2. A fibre as claimed in claim 1, wherein said stripes are
10 placed at about 1mm gradations.
3. A fibre as claimed in claim 1 or claim 2, wherein the coloured stripes appear in the same order in a repeating pattern.
15
4. A fibre having a plurality of regions printed on front and rear sides of said fibre, wherein said regions are coloured and are visible only under ultra-violet light.
- 20 5. A fibre as claimed in claim 4, wherein the regions are arranged in a pseudo-random pattern.
6. A fibre as claimed in claim 4 or claim 5, wherein said regions include regions having at least three colours.
25
7. A fibre as claimed in any preceding claim, wherein the regions are printed such that regions on the front and rear sides are in register with one another and have the same colour.
30
8. A fibre as claimed in any preceding claim, wherein the regions abut one another with no overlap of colour at the boundaries of the regions.

9. A fibre as claimed in any preceding claim, wherein the fibre is cut from a larger fibre.

5 10. A fibre as claimed in any preceding claim, wherein a varnish is applied to the outer surface of the fibre.

11. A fibre as claimed in any preceding claim, wherein the fibre is manufactured from tissue paper.

10

12. A method of manufacturing a fibre, the method comprising the steps of printing a plurality of striped regions on front and rear sides of a fibre, wherein said striped regions are coloured and are visible only under ultra-violet light, said
15 stripes including stripes having three or more colours.

13. A method as claimed in claim 12, wherein said stripes are placed at about 1mm gradations.

20 14. A method as claimed in claim 12 or claim 13 and further comprising the step of printing the plurality of coloured stripes in the same order in a repeating pattern.

15. A method of manufacturing a fibre, the method comprising
25 the steps of printing a plurality of regions on front and rear sides of said fibre, wherein said regions are coloured and are visible only under ultra-violet light.

16. A method as claimed in claim 15, wherein the regions are
30 arranged in a pseudo-random pattern.

17. A method as claimed in claim 15 or claim 16, wherein said regions include regions having at least three colours.

18. A method as claimed in any one of claims 12 to 17,
wherein the regions are printed such that regions on the
front and rear sides are in register with one another and
5 have the same colour.

19. A method as claimed in any one of claims 12 to 18,
wherein the regions abut one another with no overlap of
colour at the boundaries of the regions.

10

20. A method as claimed in any one of claims 12 to 19,
wherein the fibre is cut from a larger fibre.

21. A method as claimed in any one of claims 12 to 20,
15 wherein the method further comprises the step of applying a
varnish to the outer surface of the fibre.

22. A method as claimed in any one of claims 12 to 21,
wherein the fibre is manufactured from tissue paper.

20

23. A method of manufacturing a paper product, the method
comprising the steps of:

25 mixing one or more fibres as claimed in any one of
claims 1 to 11 or one or more fibres manufactured using the
method of any one of claims 12 to 22 with slurry paper pulp
such that the fibres form a hydrogen bond with the cellulose
fibre in the paper pulp; and

forming the paper pulp and fibre mix into a continuous
web of paper..

30

24. A paper product containing a plurality of fibres as
claimed in any one of claims 1 to 11 or manufactured using
the method of any one of claims 12 to 22.

25. A fibre as hereinbefore described with reference to and as shown in the accompanying drawings.

26. A method of manufacturing a fibre as hereinbefore
5 described with reference to and as shown in the accompanying drawings.

27. A paper product as hereinbefore described with reference to the accompanying drawings.

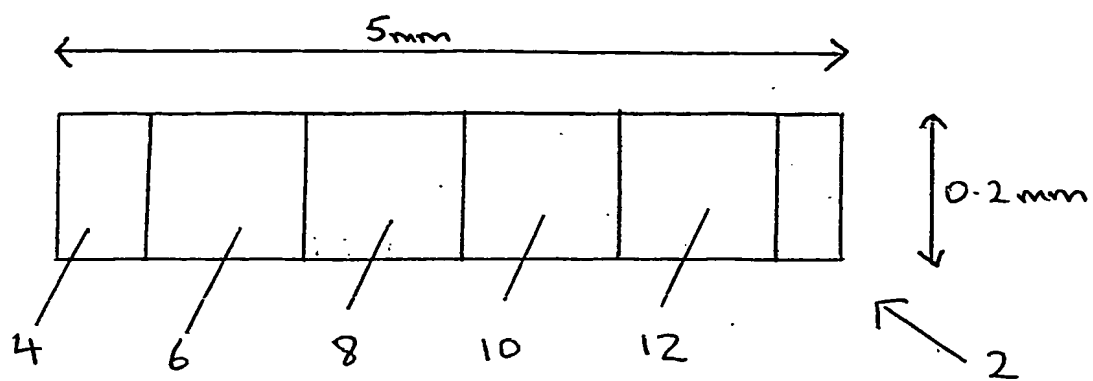


Fig. 1

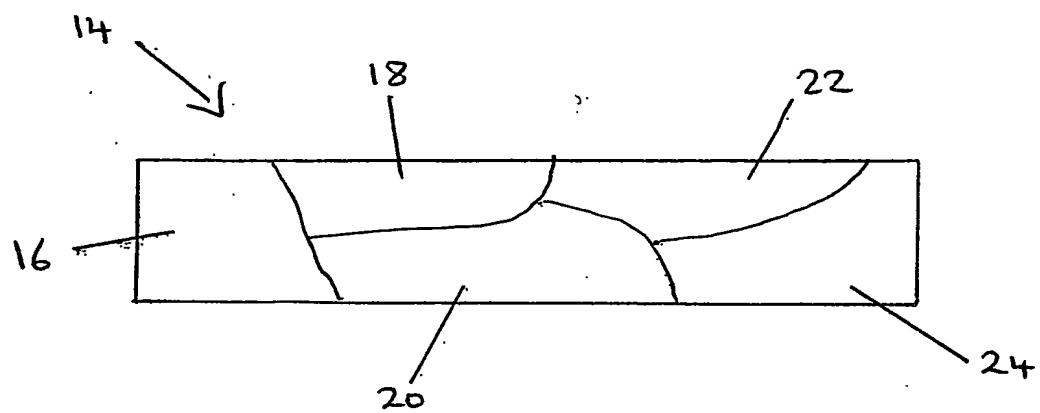


Fig. 2

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☒ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☐ **FADED TEXT OR DRAWING**
- ☒ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☐ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER:** _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.